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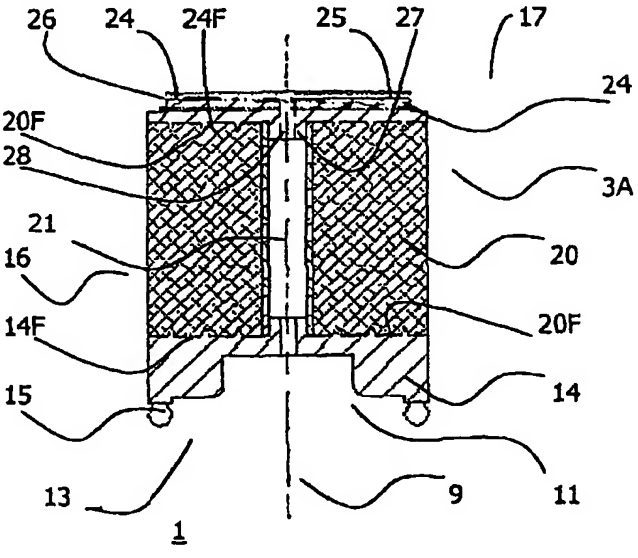
(54) Title: MICRO FILTER DEVICE FOR AN IN LINE FILTERING CONFIGURATION



(57) Abstract: Oil Filtering device (1) for filtering oil used in rotational devices, for incorporation in an in-line oil filtering configuration, comprising a filter housing (16) and a lid part (17), tightening means (10) for pressurised interconnection of said lid and the housing, the device (1) comprising an oil inlet port (3) and an oil outlet port (9) in connection with a cylindrical interior space (21) of said filter part (5; 20; 20A-20D). The device (1) comprises a micro-filtration filtering means (20) and is provided with a by pass means (25, 28), comprising an aperture in a closing member (24), connecting to the interior space (21) of the filter device (1) and comprising a pressure dependent valve means situated in, or connecting to said aperture (28), said valve means at lowest oil pressures being in a closed mode, changing to an increasing opened position in relation to an increasing actual oil pressure.

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MICRO FILTER DEVICE FOR AN IN LINE FILTERING CONFIGURATION

The present invention relates to a filter device as defined in the preamble of claim 1.

Such devices are generally known and commonly are provided with a filter part for filtering particles from oil that has contacted rotational parts such as in transmissions, and which even may have been used for lubricating engines. With nowadays increase in engine powers, the increased use of automatic transmissions with torque converters, and with the increasing refinement in valve components within such hydraulic systems it has become a desire to have refined the filtration of the oil to a considerably increased amount, i.e. by so called micro filtration. Such desire also emanates from a public convenience desire of not needing to change oil in cars, at least to have such need to a much lesser extend.

Micro filtration as such, and its effect as compared to conventional filtering is know per se, e.g. from SAE paper 2001-01-0867 "Automatic transmission hydraulic system cleanliness - the effects of operating conditions, measurement techniques and high efficiency filters", which document is hereby regarded included. Micro filters per se are also know, e.g. from international patent application PCT/NL00/00530 which is also regarded included. The known micro filter consists of radially wound more or less relatively highly compressed cellulose fibres. This type of micro filter is suitable for and known from application in a so called by pass configuration. In such a configuration the original filter of the hydraulic system remains in its original position in the flow system, i.e. remains in a so called in line arrangement, while independent from the main hydraulic stream, an auxiliary hydraulic loop is created, in which the micro filter is incorporated. The auxiliary loop may e.g. consist of only a minor part of the entire hydraulic flow, e.g. 10%. Yet, in this manner, over time this configuration effects a gradual decrease of degree of contamination of the oil up to the level of the filtering grade the micro filter. With a micro filter as known, a fill for life for passenger vehicles may be accomplished, especially since a large amount of filtered particles may be accommodated in the filter due to a relatively extremely large radial thickness of the filter material on the one hand, and on the other hand because a low degree of contamination of oil tends to slow down further contamination thereof. The requirement for an additional hydraulic flow and an additional filter device, thus for increased initial

costs, has in automotive applications up to now hampered wide spread adoption of the micro filter, despite its advantages.

It is therefore an object of the present invention to provide a solution enabling the use of a micro filter in an in line configuration, be it with lowest amount of effort, with lowest amount of initial costs, or with optimised functionality of the micro filter. According to the invention such has been realised with the measures as defined in the characterising portion of claim 1.

With a device according to claim 1, a micro filter may effectively be incorporated in an existing housing for an in line arrangement. In accordance with an important aspect of the invention, an improved Filter device is realised in that the filtering device is provided with a by pass means, such that during operation of any system in which the device is incorporated, a minimum flow of oil through the filter device is secured by said by pass means.

It is remarked that in conventional, i.e. surface based filters the use of pressure relieve valves is known for the purpose of safety in the undesired case a filter should get clogged. For ensuring supply of oil to the engine or other device in such case, a pressure valve would open at build up of pressure caused by the clogged filter. Such an arrangement is e.g. known from US patent 3.262.564, disclosing a two stage arrangement for extra safety as desired in aeroplanes. The current invention surprisingly teaches to use such type of device in combination with a high efficiency micro-filter for the purpose of solving the problem of how to enable the use of such type of filter in an in-line configuration. In such configuration, however, rather than whenever the micro-filter should ever get clogged, the valve opens with increasing pressure during normal operation, thus assuring both a proper functioning of the micro-filter device within such in-line operation and a proper supply of oil to the rotational device.

In an embodiment of the filter device according to the invention, the by pass means comprises a pressure dependent valve means situated in, or connecting to an aperture in an end closure means for the filter means, said valve means at low oil pressures being in a closed mode, while changing to an increasing opened position in relation to an increasing actual oil pressure. Preferably this way of arranging a by pass according to the invention, is realised with an elastically deformable means, having an internal passage opening up at increasing oil pressure against an internal pressure of the valve material, in particular resisting said elastically deformation with increased force at increased amount of deformation. With such manner of by pass arrangement,

a flow of oil is guaranteed in a previously describe controlled manner at relatively high operating pressures.

The invention will now be elucidated further along a drawing in which:

Figure 1 schematically represents a filter device integrated with an oil cooler device;

Figure 2 represents a cross section of a first modification of a filter device according to the invention, allowing the replacement of a conventional filter part by an e.g. cellulose fiber based, ultra fine grade filter, i.e. within the existing housing of said conventional filter, enabling both after sales replacement and factory based replacement;

In the figures, identical reference numbers relate to identical or at least comparable technical features.

Figure 1 schematically represents a filtering device 1, applied in combination with an oil cooling device 2. The device 1 is is provided with a housing 3, opened at one side that is pressingly attached, here by bolts 10, to a cooler device 2. It may either be connected directly to the housing of the cooler 2, or indirectly via a base plate not depicted, to which both devices are than attached. The filter device 1 is fed via an inlet port 3 connected via a bore 4 to an outlet port of the cooler device. The cooler receives heated oil, e.g. by an engine or a transmission, via an inlet port 6. The oil is cooled while being fed through the cooler device, which is in turn cooled by a preferably liquid cooling agent, running through a separate channel system, having an inlet port 7 and an outlet port 8. The cooled oil received by the filter device 1 is radially forced through the cylindrically shaped filter part 5 of which one axial end is closed, while the other end connects to a discharge port of the filter device. The device is provided with tightening means in the form of bolts 10, which has the advantage that a filter part 5 within the housing may be clamped against the lid without the latter being possibly affected by any rotational movement. However, the lid may in principle also e.g. be connected to the house by a threaded provision for a mutually screwed connection.

Figure 2 more in detail depicts a cross section of the filter device 1 of figure 1, however fitted with an ultra high efficiency filter for micro filtration within a generally known housing as suited for a conventional, e.g. in line filter, typically allowing a high throughput of oil and capable of filtering particles of particles of e.g. 20 μm and larger. Micro-filtration typically is capable of filtering particles of 0,5 μm and larger. Rather

than at conventional filters, which only, or at least mainly are based on a sieving principle, this result is possible since micro filtration is based both on sieving and on a polarity or binding principle where contaminations are bound to fibres. In casu the filter applied is capable of filtering particles of 0,5 um and up. One type of micro filter that may be used for the present purpose is a cellulose based filter. The housing for such conventional filter part shows an outlet port 9 accommodated in a tube shape, integrally shaped with a thickened support part 11 of the relevant wall part 12 of the housing, in casu the wall part 13 oriented axially in relation to the cylindrical filter part. In conventional application this support part 11 functions as a support for both an O-ring fitting the transition from the support base to the tube part 10. In such conventional application The O-ring in turn supports the relevant axial end of the filter part. The inlet port 3, associated with a bore or tube 4 not depicted in this figure, is provided in a locally widened housing part 3A of the filter device. The bore or tube 4 may be provided either in the lid part 17 of the housing or in the main housing part 16.

In the embodiment according to figure 2, the use of a micro filter within the structure adapted for receipt of conventional, in line oil filters is enabled by the provision of a rigidly formed filler part 14 and a large diameter O-ring fitting into the space between the thickened wall part 11 and a radial housing part 16, filling the space between the axial wall part. The filler part 14 simultaneously forms an axial end closure to the micro filter part 20. An axial end wall of the filter part stretches in a plane oriented transversely to the axial direction of the filter part. The filter part 20 is formed with a filter of which the radial thickness is substantially larger than the radius of the cylindrical inner space 21 of the filter part. The central space 21 is formed by a perforated tube part 22 forming an internal wall of the filter part 20. The other axial end of the filter part is also closed for oil passage by an other end closure member 24, also rigidly shaped and also provided separate from the filter part 20. The closure members 14, 24 are pressed against the relevant end faces of the filter part under the influence of a rigid connection between the filter housing and relevant wall part 17 associated with the cooler device 2, and of a close tolerance fitting of the relevant parts, thereby relying on a fractional axial deformation capacity of such cellulose material based filter part. An advantage of the current filtering arrangement is that the housing 16 may entirely remain unchanged. This in turn enables both the after market application of a micro filter 20 and an easy to implement factory mounting of a micro filter 20.

Also for accommodating less strict tolerances, thereby reducing manufacturing costs, a spring member 25 may be provided between the wall part 17

and the closure member 24. For the purposes of enhancing proper positioning of the filter part 20, a dimple 26 may provided in the wall part 17, receiving part of the closure element and preferably the spring device 25. In the depicted sophisticated embodiment of this feature, the closure element is provided with a small, axially exterior part that is of radially smaller width, such that the spring element may be received and straight guided by the thus created opening or groove between the dimple and said closure part. Preferably the spring is of a diameter at least almost corresponding to the outer diameter of the closure element 24, which in turn, the other closure member 14, has a diameter corresponding to that of the filter part. In this manner a relatively thick and highly loadable spring may be accommodated. The arrangement with said dimple 26 provision also positively influences the axial length of the filter part 20. Both closure elements are preferably provided with a generally cylindrical notch 27 fitting the internal space 23 of the filter device. The notch 27 of the closure member 14 connecting to the outlet port 9 is provided with a central bore for oil discharge. Especially in case the device is provided with a spring means 25, the closure members 14, 24 and the contacting faces 16AF and 16BF as described at the following figures, are preferably provided with concentric ribs which are pressed into the material of the end face 20F of the filter part 20.

In accordance with a further aspect of the invention, the filtering device is fitted with a spring member 25, while the relevant, outlet 9 opposing closure member 24 may also be provided with a bore, either fully open or fitted with a pressure dependent valve member known per se and not depicted in the figure. The filter device 1, when thus provided with a bore only, is adapted as a by pass filter system, securing a base flow of oil that is directed through the bore. At relatively high pressures, when the oil flow may not fully pass through the bore, it passes radially through the filter part 20. In this manner the filter device functions as a by pass filtering system at relatively high pressures only. Yet, in practice if at least a part of the oil passes through the micro filter, the oil will in time gradually become entirely filtered, i.e. will become cleaner up to the level determined by the chosen filtering grade. The diameter of the bore may be varied in accordance with the desired base flow and the desired percentage of oil passing through the filter part 20 per unit of time, taking into account the chosen specifications of the filter part 20.

The filter device according to this further aspect of the invention may also be provided with a valve member fitted to the above mentioned bore. In this manner a filter device is created for securing an additional oil passage in addition to the oil

passage through the filter part 20, given a certain pressure at which the oil is provided to the filter part 20. The valve member accommodated according to the invention opens wider with increasing pressure. Such pressure dependent valve member enhances certain applications or certain operating conditions where a micro filter may not allow for a sufficient flow as often required by so called in-line filter applications. The filter device according to the invention then operates as a by-pass filter, accommodated in a typical in-line filtering arrangement. Typically such valve member known per se is composed of an elastically deformable synthetic material, having a tube part with an inner cylindrical opening at one end, gradually changing into a rectangular like, and subsequently line like opening at the other end, which without internal oil pressure acting on it is closed by internal wall parts being pushed against each other. This end part of the tube may open under oil pressure under a resistance force acting against elastic deformation emanating from the combination of the particular shape and the elastically deformable nature of the material. Therefore, depending on the desired guaranteed flow rate at any pressure level, depending on the specifications of the filter, such as radial thickness, axial length and filtering grade, the valve member may be designed in accordance with a manufacturers whish.

The invention, apart from the following claims, also relates to the preceding description and all details and aspects in the drawing which are directly and unambiguously derivable there from, at least by a man skilled in the art.

CLAIMS

1. Oil Filtering device (1) for filtering oil used in rotational devices such as engine and transmission, for incorporation in an in-line oil filtering configuration, the device comprising a filter housing (16) and a lid part (17) of said housing (16), tightening means (10) being provided for pressurised interconnection of said lid (17) and the housing (16), the device (1) comprising an oil inlet port (3) and an oil outlet port (9) in connection with a cylindrical interior space (21) of said filter part (5; 20; 20A-20D), characterised in that the filtering device (1) comprises a micro-filtration filtering means (20) and is provided with a by pass means (25, 28), comprising an aperture provided in a closing member (24), connecting the space in the filter device (1) exterior to the filter part (20, 20A-D) to an interior space (21) of said filter part and comprising a pressure dependent valve means situated in, or connecting to said aperture (28), said valve means at lowest oil pressures being in a closed mode, while changing to an increasing opened position in relation to an increasing actual oil pressure

2. Filter device (1) according to the previous claim, characterised in that the valve means is at least partly incorporated in said aperture (28) of an end face closure means (24).

3. Filter device (1) according to the previous claim, characterised in that the pressure dependent valve means comprises an elastically deformable means, having an internal passage opening up at increasing oil pressure against an internal pressure of the valve material, in particular resisting said elastically deformation with increased force at increased amount of deformation.

4. Filter Device (1) according to any of the preceding claims, characterised in that the device (1) comprises a filter part (5; 20; 20A-20D) of which the radial thickness of its filter means is larger than the radial thickness of its interior space, the axial end faces (20F; 20AF-20DF) of the filter part (5; 20; 20A-20D) being formed by the filtering means of said part, and the device (1) being provided with internal, essentially flattened filter end face (20F; 20AF-20DF) contacting faces (14F, 24F, 16AF, 16BF, 17F), for axially closing a passage of oil, and having a diameter matching that of the filter part (5; 20; 20A-20D).

5. Filter Device (1) according to the preceding claim, characterised in that an oil passage closing face (16AF, 16BF) is integrated in a housing part (16A, 16B, 17).

6. Filter device (1) according to the previous claim, characterised in that an oil passage closing face (16AF, 16BF) is integrated in a housing wall part having a thickness of more than twice the thickness of the majority of the wall part of a relevant unit (16) of the housing (16, 17).

7. Filter device (1) according to any of the preceding claims, characterised in that the device is at least at one end provided with a separate oil flow closing member (24), contacting an end face of the filter part at one axial end.

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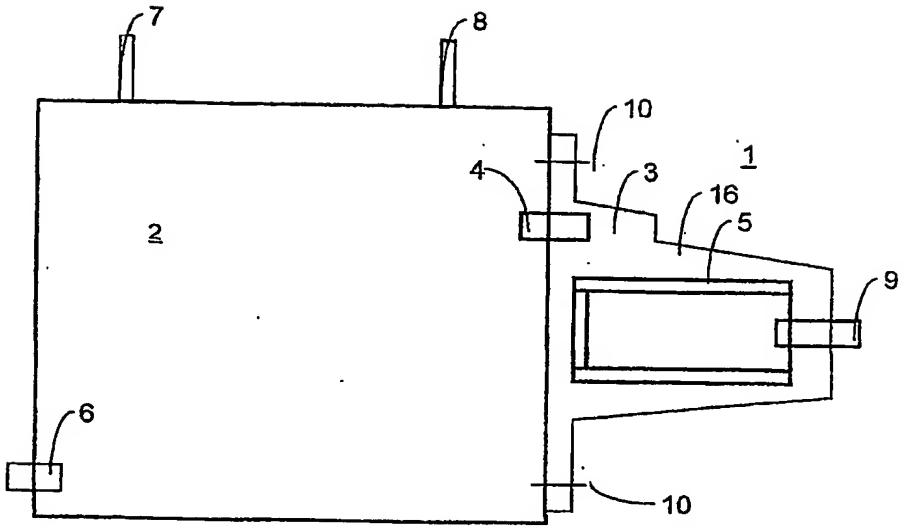
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FIG. 1

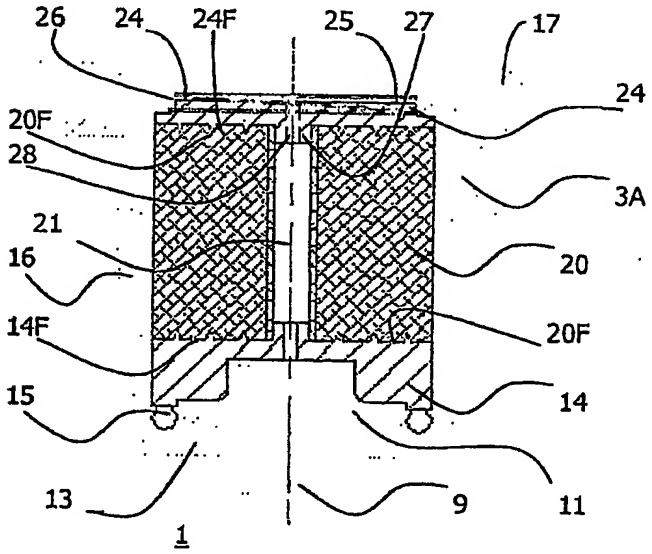
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FIG. 2

INTERNATIONAL SEARCH REPORT

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PCT/IB 03/04076

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B01D35/147 B01D35/30 B01D29/15

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 February 2004	16/02/2004

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/IB 03/04076

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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